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Moving Beyond Local Practice: Reconfiguring the Adoption of a Breast Cancer Diagnostic Technology

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Abstract

This paper explores the ways in which technological innovation becomes adopted and incorporated into healthcare practice. Drawing upon the notion of ‘field of practices’, we examine how adoption is subject to spatially and temporally distributed reconfigurations across a multi-level set of practices, ranging from the policy level to the micro-level setting of individual action. The empirical backdrop is provided by a case study of the adoption of Breast Lymph Node Assay (BLNA), a diagnostic technology innovation for the treatment of breast cancer patients. Our aim is to contribute to the development of a more comprehensive analysis of the processes surrounding the adoption and incorporation of complex healthcare technologies into routine practice.

Keywords: United Kingdom, technological innovation, reconfiguration, adoption, healthcare practice, diagnostic technology, breast cancer

Introduction

In recent years, numerous studies have examined the characteristics of innovation in healthcare and its organizational context (Berwick, 2003; Ferlie et al., 2005; Fitzgerald et al., 2002; Greenhalgh et al., 2004; 2005; Robert et al., 2010; Salaman and Storey, 2002). Such studies have identified several factors influencing the adoption of innovations. One important theme to emerge in both organisational and healthcare related literatures has been a consideration of how innovations become embedded into everyday practice (Colyvas and Johnson, 2011; May, 2013; May and Finch, 2009; May, 2006; Webster, 2002). Such concerns have led to the development of new theoretical ideas, which seek to better understand the adoption and embedding of new technologies (May, 2013). This paper contributes to this important theme in the context of technology adoption in healthcare practice.

In particular, we argue that adoption of technological innovations should be understood as an emergent and contingent process in that it is constantly defined, redefined and negotiated across multiple contexts in space and time. Adoption encompasses a broad range of phenomena, including material objects, intra- and inter-organisational relations, knowledge practices, learning, power, politics, leadership, conflict resolution and competency development, and a successful outcome may depend upon complex reconfigurations of both technologies and practices, where technologies and their contexts of use become transformed over a period of time (Latour, 2005). In Science and Technology Studies literature, the notion of configuration has been previously employed to explore the mutual constitution of social and technological change and transition (Geels, 2002; Rip and Kemp, 1998). In the context of technology development and use, Fleck (1993; 1994) provided an analysis of technological systems as technological and non-technological components (re-)configured to meet local contingencies.

This study mobilises the concept of reconfiguration to explore the ways in which technological innovation becomes incorporated into everyday practice. We seek to combine the concept of reconfiguration with ideas from ‘practice-based’ studies that have gained currency amongst organizational and healthcare researchers (Gherardi, 2010). Drawing upon Schatzki’s (2001) notion of ‘field of practices’, we argue that viewing adoption as a process involving spatially and temporally distributed reconfigurations across technologies, professionals, patients, organizations and healthcare systems provides for a more holistic analysis.

The empirical backdrop to this discussion is provided by a case study exploring the adoption of Breast Lymph Node Assay (BLNA), a diagnostic innovation for the treatment of breast cancer patients. Our study reveals that BLNA adoption requires reconfigurations across multi-level fields of practice that are not always easy to implement or even identify *a priori*. In particular, we show how reconfigurations of clinical and related work practices, and of inter-organisational relations can become a major stumbling block. In so doing, we further explore the ways in which emergent practices shape the adoption of BLNA and are shaped by it.

This paper is organised as follows. The next section summarises the literature on the adoption of technological innovations in healthcare and, in particular, the ‘technology in practice’ perspective and Schatzki’s (2001) notion of ‘field of practices’. Subsequent sections describe the methodology and the context of the case study. The case study is then presented and the main findings are discussed. The paper concludes with a discussion of the contribution to the field of technological innovation in healthcare.

Reconfiguring Technology Adoption in Practice

Social science studies have contributed towards the wider analysis of innovation processes, however, often implicitly and/or explicitly they assume a clear demarcation between functional forms of analysis, where the ‘structural properties’ of innovation are considered as key elements of success, and more critical or sociological approaches that emphasize the political nature and the social ramifications of innovation (Greenhalgh et al., 2004; 2005). Drawing upon distinctive theoretical and methodological foundations, each approach offers a different analytical lens and often contrasting explanations about the nature, role and influence of technological innovation (Timmermans and Berg, 2003). In so doing, they reduce explanation to particular disciplinary conditions (i.e. either structural properties or human agency is given analytical primacy).

More recent research on the co-adaptation of work practices and new technologies has identified alternative conceptual ways of analyzing the nexus (and effects) of agents, objects and their context in situated practice (Gherardi, 2010; Leonardi, 2009; Timmermans and Berg, 2003). Drawing upon in-depth qualitative and ethnographic studies, ‘practice-based’ studies have focused on the way people actually make sense of, and work with, technology (e.g. Hartswood et al., 2002; 2003; Jirotko et al., 2005; Luff et al., 2000; Maniatopoulos et al., 2009; McLoughlin et al., 2009; 2012). In the context of technological innovation, practice-based orientations emphasize the inherently situated and/or enacted nature of adoption (i.e. technology is implemented in a specific, local context) (Berg, 1997; Gherardi, 2006; 2010; Greenhalgh and Swinglehurst, 2011; Lehoux et al., 1999; Lehoux et al., 2004; Nicolini, 2006; Pasveer 1989). Nicolini (2006: 2755) suggests, for example, that analyzing technology in practice means “shifting the attention from the supposed effects of technology to the relationships and actions that attach meaning to the new technology and that stabilize its use within the extant work and organizational practices.” Such a perspective provides a way of

analyzing technological innovation where technology itself is considered as a more emergent and contingent socio-technical entity (Timmermans and Berg, 2003). This reflects what has been identified as the ‘ensemble view’ of technological innovation, highlighting not only the technological artefacts, but also the social and organizational aspects surrounding those artefacts, i.e. the interaction between technologies and social structures around them (May, 2013).

A distinguishing feature of practice-based approaches is their emphasis on the appropriation of technology by user organizations through local reconfigurations. This involves both “practical efforts to make technology work” in a specific context and action to “create meanings” that enable a technology to become embedded in the identity and culture of user communities (Williams et al., 2005: 55; 58). As such, new technology will be still further shaped during adoption and use in what has been called ‘innofusion’ (Fleck, 1988). Practice-based approaches highlight the highly contingent and malleable nature of technology use by identifying both *intentional* and *unintentional* changes resulting from local reconfiguration and situated innovation. In these processes, the boundary between technology, organization and use, far from being given and/or fixed, becomes both socially configured and reconfigurable, thus allowing alternative ways of constructing technologies’ potential meanings and uses.

Moving Beyond the Situated Enactment of Technology in Local Practice

Although practice-based orientations have undoubtedly shifted the focus from the effects of technology to its appropriation, it is suggested that most studies have been primarily concerned with the specifics of situated micro-level activities and local performances (Brand, 2010; Geels, 2010; Orlikowski, 2010; Schatzki, 2011; Shove et. al 2012; Watson, 2012). This focus is particularly problematic when one considers the large-scale and complex nature of

national healthcare technology innovation and implementation programmes. While exploring the situated meaning of human action and experience is fundamental to any understanding of practice, it is argued that this micro-level focus of practice “while foundational, risks missing the radical implications and potential of the concept.” (Watson, 2012: 489) In particular, it is suggested that this fascination with the detailed understanding of local practice can produce empirical and theoretical “micro-isolationism”, whereby “a local empirical instance is interpreted wholly in terms of what is evidently present, cut off from the larger phenomena that make it possible.” (Seidl and Whittington, 2014: 1408) In so doing, there is a tendency to treat organizations and thus technologies as “the isolated containers of focal phenomena” (*ibid*).

In recent years, a renewed interest in the study of practice has introduced a new ‘practice theoretical approach’, which aims to provide a framework for a more integrative analysis of social, cultural and material aspects of ‘social practices’ (cf. Reckwitz, 2002; Schatzki, 2001). As one of the key drivers of this movement, Schatzki (2001) has sought to explore ways in which social practice may be better explained by reference to different ‘fields of practices’. Drawing upon a diverse strand of social theories (Bourdieu, Foucault, Giddens), Schatzki (2001) describes practice as a ‘distinct social ontology’, which sets it apart from both functional forms of analysis and more sociological approaches. He argues that from a practice orientation “the social is a field of embodied, materially interwoven practices, centrally organized around shared, practical understandings. This conception contrasts with accounts that privilege individuals, (inter)actions, language, signifying systems, the life world, institutions/roles, structures, or systems in defining the social. These phenomena, say practice theorists, can only be analyzed via the field of practices.” (Schatzki 2001: 3) From this perspective, ‘fields of practices’ can be understood as the total nexus of interconnected/interdependent human practices (practice-arrangement bundles) that unfold

across multiple contexts in space and time. As Schatzki (2011:13) puts it “the site of the social is a mass of linked practices and arrangements spread out across the globe and changing through time. All social phenomena are slices or aspects of this mass.” This definition of practice implies that an organization consists in interrelated practices distributed across interconnected social, cultural and material orders. In this view, a hospital department, for instance, consists in interrelated practices of caring, diagnosing, treating, commissioning, advising, decision making, etc. that cut across departments, services, wards, offices, operating rooms, laboratories, and so on.

Drawing upon these ideas, we propose to move beyond the situated enactment of technology in local practice towards the wider landscape of interconnected practices distributed in space and time. In so doing, we seek to develop closer connections between the micro-level reconfigurations and the wider socio-political arrangements shaping the adoption and the embedding of technological innovation in healthcare. For the purposes of this study, adoption is considered as a process of spatially and temporally distributed reconfigurations across technologies, professionals, patients, organizations and health systems. Such reconfigurations are distributed across a multi-level set of practices, ranging from the macro-political economy context to inter-organizational arrangements between healthcare organizations and the micro-level setting of individual action. It is important to note here that this does not imply an ‘order’ of the social practice, with a pre-existing ‘top’ and ‘bottom’ hierarchy/dichotomies of cause and effect. Rather, we argue that ‘levels’ are just “different components or sectors of a single plenum embracing spaces of innovation and spaces that perpetuate the past and present.” Schatzki (2014: 16) From this perspective, local practices are both the medium and outcome of larger reconfigurations (and vice versa) they recursively organize across multiple contexts in space and time. It is the actual process of reconfiguration across interconnected ‘fields of practices’ that enables innovations to become embedded in everyday practice.

Research Setting and Methods

This article draws upon a three year UK research study, which explored the organizational and policy context for successful technology adoption in a national technology innovation and implementation programme in the National Health Service (NHS) in England. We examined the adoption of three healthcare technologies: insulin pump therapy; a breast lymph node metastases diagnostic (BLNA); and an ultra-wide field diagnostic for retinal imaging (Llewellyn et al., 2014). This paper reports on the adoption of BLNA.

The NHS National Technology Adoption Centre (NTAC) was set up with the aim of increasing the adoption of technological innovations that had been identified as having the potential to deliver significant benefits to the healthcare system and its patients (NTAC was subsequently absorbed within the National Institute for Health and Care Excellence (NICE) (www.nice.org.uk) as the Health Technologies Adoption Programme. See www.ntac.nhs.uk). It functioned as an advisory body on policy to the UK government and as a ‘change agent’, promoting the uptake of technologies through its Technology Implementation Projects. In 2008, NTAC announced a call for proposals for its Technology Implementation Projects and BLNA was one of the innovations selected. The evidence base for BLNA was considered strong and adoption was consistent with the National Institute for Health and Clinical Excellence’s guidance for breast cancer care (NTAC, 2011):

The intra-operative analysis of sentinel lymph nodes offers the opportunity to streamline the management of breast cancer patients as part of a cohesive and comprehensive service, and according to a review in the *Histopathology Journal* (July 2009), this test is accepted as a reliable technique.

Hospital Trusts (a Trust is a division within the NHS providing healthcare services (e.g. acute care) within a geographical area) across England applied to take part in the implementation

project in the spring of 2008 and four sites were selected. These consisted of a ‘mentor site’ (a Trust that had already adopted the technology and which would provide support for the other sites, ‘MS’ in Table 1 and following text) and three ‘implementation sites’ (IS 1, 2 or 3) (Trusts that wanted to introduce BLNA).

Following NHS (Regional Research Ethics Committee), and local R&D approvals, participants were approached to take part in the study. Purposive sampling was employed to ensure inclusion of all relevant individuals. Participants included clinicians, chief executives, procurement/commissioner managers, project managers, and other specialists. Two researchers (GM and RP) conducted the fieldwork.

Data collection was based on semi-structured interviews (34 in total; see Table 1) between March 2010 and September 2011 with key informants at each site, supplemented by participant observation of project meetings, and review of Trusts’ internal documents and policies related to technology adoption. Participants were provided with information sheets in advance, and consent forms signed prior to the start of the interviews. All interviews lasted between 60-90 minutes, and were digitally recorded and transcribed.

Interviews were supplemented by observations of 4 meetings, organised by NTAC, where representatives of each participating Trust gathered to be updated on the current status of the project and to discuss issues related to its execution. These meetings were conducted away from participants’ sites and involved a wide range of stakeholders (clinicians, histopathologists, nurses, procurement officers and other Trust managers). For reasons we describe in more detail below, these meetings were often tense and involved a high level of uncertainty among the various participants about the required changes in clinical protocols.

Transcribed interview data and fieldwork notes were analysed using thematic analysis to generate category systems and repeated themes (Boyatzis, 1998). Drawing upon an

interpretative approach, themes were developed in an iterative and inductive way, breaking down and reassembling the data through a coding process. For the purposes of inter-coder reliability, two (GM and RP) researchers analysed the data independently. These were later discussed and approved by the research team. For confidentiality reasons, all participants have been anonymised.

It is important to note that the timeframe of the study meant that we were only able to observe a specific period within an ongoing and potentially drawn out adoption process.

TABLE 1 ABOUT HERE

Breast Lymph Node Assay

Breast cancer affects more than 45,000 women each year in the UK (Cancer Research UK, 2013). Under the established breast cancer clinical pathway, a patient diagnosed with breast cancer will undergo a mastectomy, during which the so-called 'sentinel lymph' node is removed and tissue sent for analysis (Cserni, 2012; Layfield et al., 2011; Somasundaram et al., 2011). If this biopsy shows that there has been a metastasis (i.e. the cancer has spread to the sentinel lymph node), the patient is then readmitted for a second operation to remove the remaining (axillary) lymph nodes. Apart from the additional psychological stress from having to endure a second hospital admission and operation, the current pathway can pose a clinical risk for patients as the cancer has further time to metastasise.

BLNA is a new diagnostic technology, the results of which can be ready within 30-45 minutes and so can be completed intra-operatively. If metastases in the lymph nodes are identified, surgery is extended to allow the remaining lymph nodes to be removed. Hence, BLNA represents an improvement on patient care, as measured by fewer bed days and a shorter care pathway, and patient outcomes, as measured by increased survival rates (Layfield et al., 2011; NICE, 2009).

Findings

In the following sections, we explore BLNA adoption issues as they touched on a number of interrelated “fields of practices”, ranging from the patient pathway, the non-surgical practice of histopathologists in the pathology lab, clinical practice in theatre, as well as the inter-organisational arrangements between healthcare providers (i.e. the Trusts) and commissioners, and, finally, the wider political economy of healthcare policy.

Reconfiguring the patient care pathway

Patient benefits

Our evidence points clearly to BLNA being an innovation championed by clinicians. All the surgeons in the participating Trusts stressed that their support for BLNA was on account of the important benefits it would have for patients:

Surgeon 2, IS3: *Well to be honest it was a no brainer, you’ve got reduced length of stay, reduced hospital visits, reduced anaesthetics, theatres, reduced surgeon’s time ... it was a no-brainer that if you could do this as a one-hit operation then that’s what patients would want.*

Trust managers also saw a clear clinical case for adoption and savings for the health economy:

Director of strategy and planning, IS2: *Because clearly that’s good for patients because it reduces the number of operations. It’s good for clinicians because they get a result quickly, and it’s good for the people who are paying our bills because they see a saving.*

Reconfiguring patient management

While a shorter care pathway and fewer hospital inpatient episodes would be welcome to patients, there were side effects that might put patient acceptability in question. These stem from the fact that the exact course of the procedure would depend on the outcome of the BLNA. Dealing with them would require some reconfiguration of patient management, but how much was not initially clear. Most straightforwardly, there would have to be a change to the consenting process so that surgeons could proceed with the removal of the auxiliary nodes if the BLNA was positive:

Surgeon 2, IS3: *The patient's consent has to be careful because the patient is consenting for a sort of either/or option and therefore consent can be arguably a little bit difficult, because you're saying to a patient, we're going to do this, if it's positive, we'll do your axilla and if it's not, we won't and therefore there's an uncertainty. The patient's going to wake up with an uncertainty. The first thing they're gonna say to you is, was my axilla clear?*

Surgeons did not anticipate the need for major changes to the consenting process. In contrast, breast care nurses emphasised the need to consider the psychological impact for patients of the 'one-step' rapid diagnostic test and instant clinical intervention:

Breast care nurse, IS3: *Yes as you say, it is really for them, the uncertainty of, you know, will the test come back showing that I don't need to have any lymph glands removed, therefore, you know, my cancer is not as bad as it could be. Or if they come back positive then, oh dear my cancer is, you know, as bad as it can be ... And it's the psychological impact of that.*

Their view that insufficient attention had been paid to how they would manage patients' responses to this uncertainty, suggested a divergence in understanding of the challenges of managing the patient among surgeons and nurses:

Consultant Nurse, MS: *I think what we haven't thought through with this technique is how we support patients ... The patient will go to sleep with uncertainty about what they will wake up to. ... So that nobody really had a lot of consultation with her about that dread that she felt when she woke up'.*

Breast care nurses argued for the provision of post-operative support for patients, as one surgeon acknowledged, while pointing out that this would have cost implications:

Consultant breast surgeon, IS1: *The breast care nurses would like to be there for the patient when they're waking up so that, you know, they're waking up and they know the prognosis is not so good, but they've got someone who they know and who has some expertise. And so that's time and money for the breast care nurses as well.*

In summary, surgeons and nurse were in agreement about the benefits of BLNA for patients. Both groups also recognised that changes to patient management would be necessary, but they differed in their views about what changes should be implemented. Reconfiguration of patient management would be the least complex of adaptations that would be required for BLNA adoption.

Reconfiguring non-surgical workflow and practices

Adoption of BLNA would only be possible with reconfigurations in clinical workflow and practices across various departments: surgery, pathology, outpatients, follow-up clinics, etc. Indeed, while the adoption of BLNA was expected to demand reconfigurations of non-surgical and clinical practice, their exact form and how significant they would turn out to be

depended on local factors at each site, necessitating, in some cases, a lengthy series of negotiations within and between the different staff groups involved.

Histopathologists' workload

Pathology staff would now have to be available to test tissue samples on demand, a change that increased the pressure on them. The test had to be completed within a short time frame, which meant that a histopathologist had to be available:

Histopathologist, IS2: *...the big thing for us is we knew it was going to be a high pressure test with a lot of pressure on a biomedical scientist to provide that result accurately and quickly with a surgeon banging on your door.*

Hence, there was a general concern that the short time available to conduct the test would make histopathologists' job more difficult.

Spatial reconfiguration

The need to complete the test quickly also meant that the sample had to get to pathology with minimum delay. Where pathology was in the same building as theatre, this was not a problem. In other cases, the solution was having "runners" available to collect samples from theatre as soon as they are ready, or adapting a room close by for pathology use. The latter had significant cost implications:

Clinical lead, IS2: *There's a room identified ... that can be used yes so that's why we are going to build, well they have to remove this and make it into a proper lab and that is going to cost about £14,000.*

A consequence of physically relocating the assigned histopathologist close to theatre was that they would be deprived of support of colleagues when faced by a difficult diagnosis, thereby increasing the risk of error:

Histopathologist, IS2: ... *there will be a single biomedical scientist isolated away from their colleagues in a room with a surgeon wanting a result. Here [in the lab], if you're struggling with a frozen section because it's difficult to cut you can call on a colleague, There, you won't be able to do that, you will be isolated and that's, to me is the real difference...*

There were also concerns that the combined effects of these individual changes to pathology lab work might result in the need to recruit additional staff, further escalating costs:

Biomedical scientist, IS2: *We are without a doubt having to struggle badly for staff when this gets implemented, 3 days a week with a qualified member of staff out to satellite lab [in theatre] all day, it's going to hit us hard.*

In summary, pathology staff faced several challenges from BLNA adoption, ranging from the impact of time pressures and, in some cases, isolation from other laboratory members on the reliability of results, to dealing with the additional workload.

Reconfiguring surgical workflow and practices

Management of theatre lists

Extra time would be needed in theatre when the BLNA was positive, making management of theatre lists more complicated. However, while this was anticipated by surgeons and theatre staff, how these changes should be best managed was a matter of continuing debate during project meetings and involved managing a high level of uncertainty among the various participants about the required changes in clinical protocols. From a clinical perspective, changes to theatre list management were, to some extent, a matter of trial and error:

General Manager of Surgery, MS: *So there are going to be some patients that will need the clearance, and others won't, so what are we going to do about that? ... Theatre planning, in terms of advance planning we don't know how much of that*

theatre capacity will be needed ... we're trying to get a better throughput in theatres, this conflicts with that slightly, in terms of having to allow the flexibility to, to have an extra 15 or 20 minutes on the session for each of these procedures, not all of which would be used ... the figures I've got is 28 to 30 percent would need the further surgery.

Given these concerns, getting theatre staff on board was perceived to be a major concern for BLNA adoption:

Biomedical scientist, histology, MS: *It became very difficult to get theatres to agree to go live, to actually start acting on our results ... because if the result is positive, then further surgery will ensue, this could go on for another half hour to an hour, if you have three cases on the list ... if they're all positive then that list is going to overrun ... That was my biggest barrier, was getting the theatre staff on board.*

Various changes to theatre management were being experimented with as a way of mitigating the knock-on effects of additional surgery:

Surgeon 2, IS3: *It's 40 minutes for the surgeon to twiddle their thumbs and surgeons don't like twiddling thumbs. So we work around that you go in, you do your sentinel node, you send it off and then you tackle whatever breast pathology you're dealing with.*

One approach was to assume test results would be negative and to 'close up' patients while waiting for the result:

Surgeon 2, IS3: *The phone call comes, negative, wake the patient up. The drip is already on, the stitches ... the wound's already closed ... If the phone call says it's*

positive, then basically just get gowned and gloved, the registrar's there, takes the dressings all down, cuts the skin and stitches back, we're straight back in.

However, such 'in surgery' workarounds have their limitations:

Consultant histopathologist, MS: *You get the list and there may be two sentinel lymph nodes on there first and second cases and you think: Excellent. But something happens and for some reason, either the patient's cancelled or they get pushed down the list and then you've got the person waiting over there to do the assay not doing anything else ... then it's basically wasted time.*

Consultant Breast Surgeon, MS: *[If] it finishes late then you've over utilised your list and conversely if you've got three patients on and you're expecting one of them to be positive and none of them are positive you may underutilise your list.*

Hence, a question that preoccupied surgical teams at each Trust was how best to organise the theatre list to accommodate the possibility of a patient requiring a second procedure while limiting the disruption to the list as a whole. One approach was based on trying to predict which patients would be more likely to test positive:

Clinical lead, IS2: *If somebody has a high risk tumour, a grade three tumour which is large it is more likely that they are likely to be positive than somebody with a smaller tumour which is grade one or grade two. So you will want to leave the grade three ones towards the end of your list rather than, because if you do the grade three ones in the beginning and then it's positive then you're going to spend more time*

Surgical and non-surgical workflow coordination

Theatre list management issues emphasised how BLNA adoption depended on a closer coordination between theatre and pathology teams:

Clinical lead, IS2: *And also you want to do it within time because the pathologist maybe has to leave at five o'clock so you don't want to leave your last sentinel lymph node later than four o'clock. So you want to do that within time and this procedure has such a crucial working relationship with the pathology department actually.*

However, despite theatre staffs' efforts, there could be no guarantee that things would go according to plan. In extreme cases, operations might have to be cancelled, but this risked disruption to wider theatre list planning, quite apart from the stress and anxiety inflicted on the patient. Overall, reconfiguring non-surgical/clinical workflow increased pressure on histopathologists and the possibility of disrupted theatre lists, with negative consequences for patients, theatre staff, workflow and costs.

Reconfiguring inter-organizational relations and practices

Making the business case

Any decision to adopt BLNA would be subject to Trusts gathering evidence and making a business case: weighing up cost savings and additional costs incurred. For Trust managers, having to negotiate with different staff groups made making the business case for BLNA that much more difficult:

Operational manager for breast, IS1: *The complication with this is that you're working with the labs and you're trying to pull the business case together for lots of different factors, whereas generally, as a business case, you'd write it for yourself and your own department. You're trying to sort of pull it together from all different areas.*

Once compiled, the business case would be prioritised against competing business cases:

Operational Manager for Breast Care, IS1: *We started to work up the business case for the inter-operative analysis alongside other business cases for breast care ...*

The one that didn't go forward was the intra-operative assessment analysis, and that's the one that we're putting forward this year ... Because there's only a finite amount of money ... and that scheme was not given priority ... It would be quite surprising to get support for more than one big business case actually in one directorate.

One reason why BLNA might not be prioritised would be the lack of a national tariff. Payment by Results (PbR) is the system in NHS England under which commissioners pay healthcare providers for each patient treated, taking into account the complexity of the patient's healthcare needs (Department of Health, 2012a). Innovations such as BLNA may not be covered by national tariffs because, initially, they are offered by few Trusts (Department of Health, 2012b). In such cases, a local tariff, or 'pass-through payment', must be negotiated between provider and commissioner. In this context, adopting BLNA presented Trusts with a major problem. Put simply, commissioners (at the time of study, commissioners were Primary Care Trusts (PCTs). These have since been replaced by Clinical Care Commissioning Groups) stood to gain from reduction in bed days and theatre time because two operations were being replaced by one, while the providers, the Trusts, stood to lose income for the same reasons:

Pathologist, MS: *What we did have to do was put a business case together and convince the Trust's Planning Committee that that was a good idea. Clinically and financially. In fact I think they got their sums wrong and we probably shouldn't have been doing it! What I hadn't realised was that saving the NHS money did not necessarily save the Trust money. It saves the PCTs money but the PCTs don't pay that money to the Trust so the Trust actually loses money. It is much better for the*

Trust to do two operations rather than one because they get two tariffs. Which is one of the crazinesses.

Consultant breast surgeon, IS1: *The Trust actually loses money in that they don't get the income from the second operation anymore ... it does mean that from a financial point of view and a service provision point of view ... there may be some reticence from a hospital to lose income, even if it's also less work.*

One strategy was to look for savings elsewhere:

Operational manager for breast, IS1: *As a pragmatic business manager, you have to say that if this is going to cost you [the Trust] more [because] you're losing income, [and] the assay alone is £250 a time, plus all the lab costs. So the only way we could take that hit is either to get more money from the commissioners or to make savings within our own department to offset the cost. And that's the difficulty we have; how can we identify savings to support this?*

Some saw the root of this problem as the 'silo' culture, where departments operate as independent units, and argued that the healthcare economy would benefit from a more integrated approach:

Lead pathologist for breast pathology, MS: *Throughout the Health Service there's no global view. Every section has to worry about its budget so that if one section saves money for somebody else they may be penalised but the other section benefits, whereas what actually matters is that the patients are getting a better service and potentially is saving money as well.*

Negotiating a tariff

The financial barrier to BLNA adoption could only be resolved through negotiation between the Trusts and their PCTs of a pass-through payment that was acceptable to both parties. Much would then depend on the relationship between the Trust and its PCT:

Operational manager for breast, IS1: *I would say we have a good relationship with our commissioners, but we all recognise that we're not in a time of plenty ... The best outcome would be if the commissioners said, "Yeah, we recognise it's best for patients. We accept it's a cost pressure to you. We will give you a local tariff," which is over and above what we get for PbR, then we'd be fine ... But it's not going to be that easy because the commissioners have an efficiency target to meet as well and, you know, they've got lots of other services that are coming to them in the same way with innovation.*

Reflecting on previous experiences, IS2 staff felt that local negotiations between Trusts and PCTs could be a lengthy process:

Directorate manager of pathology, IS2: *Having been through the process on several occasions you know with business cases, it always seems to come down to those local negotiations that are going to go on between the PCT and the Trust and that in reality is what's taken the time to get sorted out.*

In summary, without some flexibility in the contractual relations between Trusts and the PCTs to enable negotiation of a mutually acceptable pass-through tariff, resource issues made the creation of a credible business case for BLNA difficult if not impossible.

Reconfiguring commissioning policy and practice

In the view of Trust business managers, the reluctance of PCTs to share the financial implications of adoption had a powerful, negative impact on their capacity to innovate and led them to question the lack of push for innovation at a national level:

Operational Manager for Breast care, IS1: *So why isn't there a dialogue at a national level between the PbR national guidance around tariff and innovation? So if you could have done that in the very early stages to say this is a new innovation, you know, we recognise it costs more than the current one but the patient experience is so much better, if it would actually come with a new tariff, then, actually, you'd be halfway there ...*

One consequence was that there was the lack of a clear process for Trusts to follow when negotiating a pass-through payment:

Assistant Director of Commissioning, IS3: *And we came together with well what on earth, there must be a mechanism under the tariff in some way of introducing an incentive to put this in place ... a pass-through payment ... What happened was our finance person contacted the strategic health authority [Strategic health authorities were responsible for implementation of national healthcare policy in England at regional level. They were abolished in 2013] who contacted the Department of Health to find out how we could work this, because I think initially for us in the first year it was going to be more expensive ... So we had to justify that..*

At a policy level, NTAC attempted to persuade the National Institute for Health and Care Excellence (NICE) that, if the latter made a technology mandatory it, should also create an interim tariff for it, but this came to nought:

NTAC, CEO: *NICE puts out a guideline for a new piece of technology, which may not have a tariff. It tells the Trust they have to adopt it but it doesn't tell them how they're going to get paid for doing that. What I was trying to push NICE to do is create an interim [tariff] for the moment that the guidance is given so that a Trust can start using it and develop some reference costings around it. But that's going to take time coming through and NICE, of course, is going to have to change.*

In summary, without a reconfiguration of commissioning policy and practice, any innovation whose adoption might result in financial penalties for healthcare providers (or, indeed, commissioners) might struggle to get adopted. Perhaps in recognition of this problem, a subsequent report on 'Innovation, Wealth and Health' (Department of Health, 2011) stated that healthcare commissioners should "adopt best practice" as part of their legal duty to innovate.

Discussion

Drawing upon Schatzki's (2001) notion of 'field of practices', this paper has explored how technology adoption depends on reconfigurations distributed across a multi-level set of practices. We explored these issues through a case study of the adoption of BLNA, which illustrated how it is difficult – if not impossible – to propose a 'standard' pathway for its embedding into healthcare practice. Although the adoption of BLNA promised benefits over existing practice(s) such as the opportunity to streamline the management of breast cancer patients, we saw how its adoption also involved reconfigurations across a multi-level set of work practices that were not always easy to implement.

When the Trusts in this study began to prepare the ground for BLNA adoption, the prospects must have seemed good, the basic case was strong and, when looked at from the perspective of the NHS as a whole, unambiguous in terms of patient benefits and cost reduction, and

consistency with NICE guidelines for breast care. Surgeons were unanimous about the patient benefit and their role as organizational champions clearly made a difference (Hendy and Barlow, 2012). Our data however, suggests that whilst organizational champions can be important facilitators of technology adoption, reconfigurations of work practices within and across departments and professional groups (Ferlie et al., 2005) to support the adoption of BLNA requires much more. In particular, BLNA adoption called for a number of significant reconfigurations in working practices of non-surgical and clinical teams, some of which could be anticipated in advance, while the nature of others would only become clear over time. It necessitated the need to train pathology lab staff in the skills required to perform the assay, a task that was relatively easily satisfied. Trusts found it less easy, however, to meet a core requirement – rapid testing and reporting back of results, which demanded closer coordination between surgical teams and pathologists. We saw different ways of achieving this at each Trust, some of which were acknowledged to introduce some potential risk to the reliability of testing procedures. Ideally, the assay would be done in theatre, in an adjoining room or, at least, in the same building. However, not all of the Trusts could satisfy this requirement without making significant changes: e.g. relocating pathology; creating a new ‘satellite’ pathology lab next door to theatre; using ‘runners’ to take the biopsy to the pathology lab and return with the results, which added to costs. In line with our findings, previous studies have pointed out the ways in which new technologies, such as BLNA, have the potential to modify the form, structure and range of settings and communication methods used within healthcare practice (Poland et al., 2005; Andrews and Evans, 2008).

The need for such reconfigurations offers an important insight for understanding how emergent practices are shaped by – and shape – innovation. BLNA demanded some reorganisation of pathology lab work, as surgical and pathology teams have to work more closely together. At a minimum this meant that histopathologists would have to be ‘on-call’

whenever a breast cancer surgery list was scheduled, which raised concerns that they would be unable to carry out their other duties at these times. For some Trusts, this also meant providing a 'satellite' testing facility in close proximity to theatre. Such changes raised concerns among histopathologists about the impact on the reliability of results of time pressures and isolation from other lab members. Regarding the latter, the workplace studies research literature on the role of co-location for the routine achievement of dependable work in medical and other work settings (e.g. Buscher et al., 2010; Hartswood et al., 2002; 2003; Jirotko et al., 2005; Luff et al., 2000) substantiates their concerns about the risks involved.

At the clinical pathway level, we saw how multiple tensions exist between the requirement for reconfigurations to incorporate technology adoption in healthcare practice on the one hand and the inherent uncertainty of context and process (i.e. service model) on the other. Reconfiguration of theatre lists was necessary as BLNA had the potential to cause both under-runs and over-runs of theatre lists. How such reconfigurations would be done would vary from Trust to Trust. Overall, it was felt that BLNA made the management of theatre lists more complex, as provision had to be made for additional surgical time, but which patients would need it could not be predicted with complete confidence in advance. Service level adaptation was required not only for breast cancer surgery itself, but also for outpatients, follow up clinics, bed use on main wards and other services that shared facilities.

At an organizational level, the adoption of the BLNA required addressing uncertainty about the effectiveness of a proven business model. From a commissioning perspective, making a case for BLNA adoption demanded significant inter-organisational work if Trust management – and other stakeholders – were to be convinced that this could be done within acceptable levels of risk – financially and operationally (Llewellyn and Northcott, 2005). In particular, the lack of a national tariff for BLNA necessitated reconfiguration of commissioning policy and practices, through the negotiation between Trusts and their PCTs

of a ‘pass-through’ payment. As we have seen, these negotiations were contingent on the quality of the working relationship between Trust and PCT. Such uncertainties make it difficult to incorporate services such as the BLNA in practice and without any local negotiations and agreements over funding arrangements they can become a major stumbling block. Overall, the lack of a funding model for BLNA meant that value for money assessment would be difficult for any Trust considering adopting the technology.

From a policy perspective, the 2011 UK government report on ‘Innovation, Wealth and Health’ (Department of Health, 2011) recognised that patients should have access to the latest diagnostics and innovations which is key to improving the health and wealth of the state, as well as creating opportunities in private sector for healthcare suppliers. Despite the government’s policy objectives, Trust business managers described problems of ambiguous or incompatible policy related to national guidance around national tariffs and innovation. Moreover, political issues surfaced most clearly in the relationship between providers (the Trusts) and commissioners (PCTs) of services, which, for provider business managers, were defined by PCT unwillingness to find an equitable solution to sharing costs and benefits. In their view, this had a powerful, negative impact on the NHS’s capacity to innovate. As such, unless reconfigurations at a policy level were taking place towards the development of a funding model for BLNA, its incorporation into routine practice would be very difficult for Trusts.

In sum, this study advances the study of technology adoption in three ways. First, it broadens the scope and scale of analysis across the different set of practices that contribute towards the successful adoption and incorporation of technology in healthcare. In this study we have not simply examined reconfiguration processes within a particular setting of practice, but rather have explored reconfigurations distributed across a multi-level set of practices, ranging from the policy level to the micro-level setting of individual action. In this way, and by offering a

more holistic view of technology adoption, we show how success hinges on how organizations, user communities and technologies become reconfigured across interconnected social, cultural and material orders. This is of increasing importance, as maximising the effectiveness of technology adoption in large-scale national healthcare technology innovation and implementation programmes demands greater understanding of the reconfigurations processes across the different sets of practices.

Second, our theoretical positioning stresses the importance of being sensitive to the broader context of reconfigurations in which technology adoption is located (Brand, 2010; Geels, 2010; Watson, 2012). In so doing, our findings reinforce the importance of moving beyond the boundaries of local practice towards a broader perspective of interconnected practices shaping the adoption and the embedding of technological innovation. Much of the existing literature around the adoption of innovation in healthcare has focused on the technical/structural properties of adoption or has investigated specific interactions between professional groups, rather than exploring adoption as a process over a field of interrelated practices (May, 2009; Robert et al., 2010).

Finally, this study explores the reconfigurations of technology adoption as experienced by the practice of a wide range of stakeholders, including clinicians, chief executives, procurement/commissioner managers, project managers, and other specialists. As such, it provides insights from a variety of different perspectives, thus revealing the multiple professional, organisational and social factors that influence and shape the adoption process. In so doing, it highlights the issue that however efficacious an innovation may be, its adoption in everyday practice can - by no means - be assured.

Conclusions

In conclusion, this paper has used an empirical case study to illustrate how technology adoption is a diverse and contingent process, constantly defined, redefined and negotiated. The case study enabled exploration of how the social, the material and the spatial properties of adoption become reconfigured across a distributed 'field of practices'. Our particular contribution in this paper is to extend the notion of reconfiguration across the multiple levels that shape the adoption of technological innovations in healthcare. We acknowledge that a potential limitation of our analysis is the focus on a single innovation case study, which raises questions about the extent to which this is common to technological innovations in healthcare. We would suggest that this presents a useful area for exploration in future studies, given the well-recognised problems in translating innovations in healthcare. Through opening up this avenue of inquiry, our aim is to contribute to the development of more comprehensive analysis of the reconfiguration processes surrounding the adoption of complex healthcare innovations into practice.

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Table 1: List of interviewees

Organisation	No. of interviews	Interviewees
Mentor site (MS)	5	Consultant surgeon Pathologist x 3 General surgery manager
Implementation site 1 (IS1)	8	Consultant surgeon x 2 Breast care nurse Pathologist x 2 Pathology manager Procurement manager Operational manager for breast care
Implementation site 2 (IS2)	9	Consultant surgeon x 2 Breast care nurse Biomedical scientist x 2 Pathology manager Breast care nurse Procurement manager Director of planning
Implementation site 3 (IS3)	10	Consultant surgeon x 2 Cancer clinical director Pathologist x 2 Breast care nurse Pathology manager Procurement manager Operational manager Data manager
Primary Care Trust (for IS3)	1	Assistant director of commissioning
Community research group	1	Volunteer
Total	34	

- We explore the ways in which a breast cancer diagnostic technology becomes adopted
- We identify reconfigurations across a multi-level set of practices
- Reconfigurations are not always easy to implement or even identify a priori
- Unsuccessful reconfiguration processes could become a barrier to technology adoption